

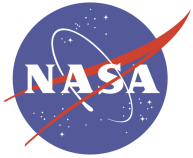
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# Computing, Information, and Communications Technology (CICT)

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Program Manager  
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***TGIR Conference  
May 22, 2002  
Santa Clara, CA***





# Outline



- Overview
- Scenario/Accomplishments
  - **Advanced Computing and Communications Systems** for Earth Science, Aerospace, and Human Spaceflight
  - **Autonomy** for Future Space Science Missions
- Role of CICT in Technology Development and Maturation





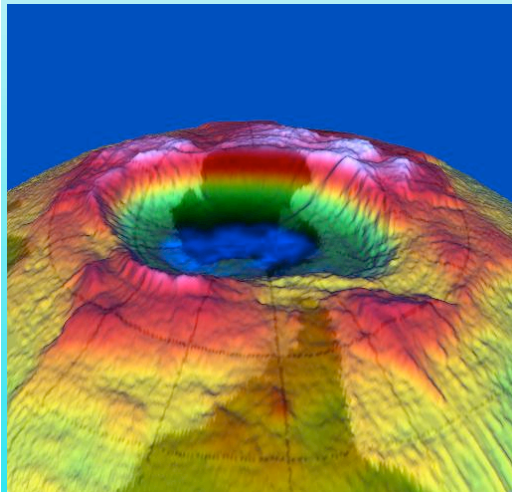
# CICT Program Goal



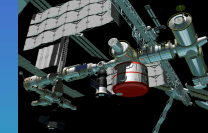
**Enable NASA's Scientific Research, Space Exploration, and Aerospace Technology Missions**

**with greater mission assurance, for less cost,  
with increased science return**

**through the development and use of  
advanced computing, information and  
communications technologies.**



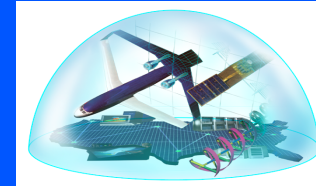
# CICT Program Structure



## Intelligent Systems



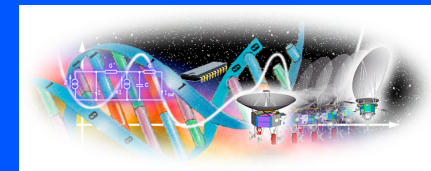
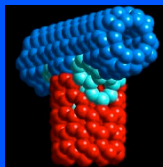
## Computing, Networking and Information Systems



## Space Communications



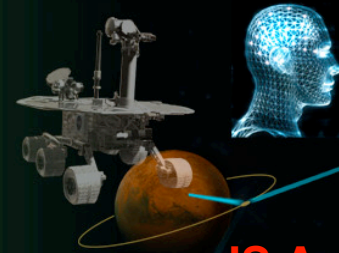
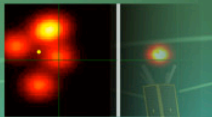
## IT Strategic Research



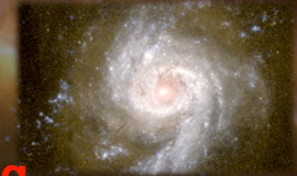
# CICT Program Overview

## Integrated Capability Goal

**IT Strategic  
Research**



**IS Automated Reasoning**

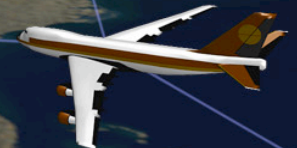
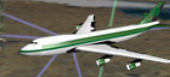
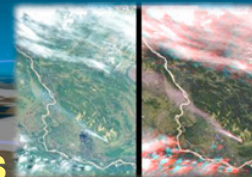


**Space Communications**



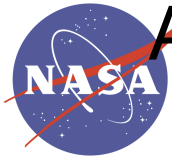
**IS Intelligent Data  
Understanding**

**Computing, Networking and Information Systems**



**IS Human-Centered Systems**





# Advanced Computing and Communications Systems



**512 CPU SGI O2K**

**1024 CPU SGI O2K**



## **CPUs**

**1024 (MIPS R12000)**  
**400 MHz CPUs**  
**800 MFLOP/s per CPU**  
**819 GFLOPS total**  
**8 MByte cache per CPU**  
**8 GByte total Cache**

## **Memory**

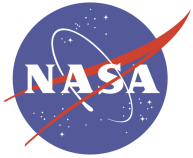
**256 GB main memory**

## **Disk**

**4 TB FC Raid disks**

## **System Software**

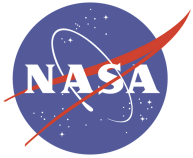
**OS single system image**  
**Single XFS File System**  
**Compiler parallel 1024 CPUs wide**



# Earth Systems Modeling

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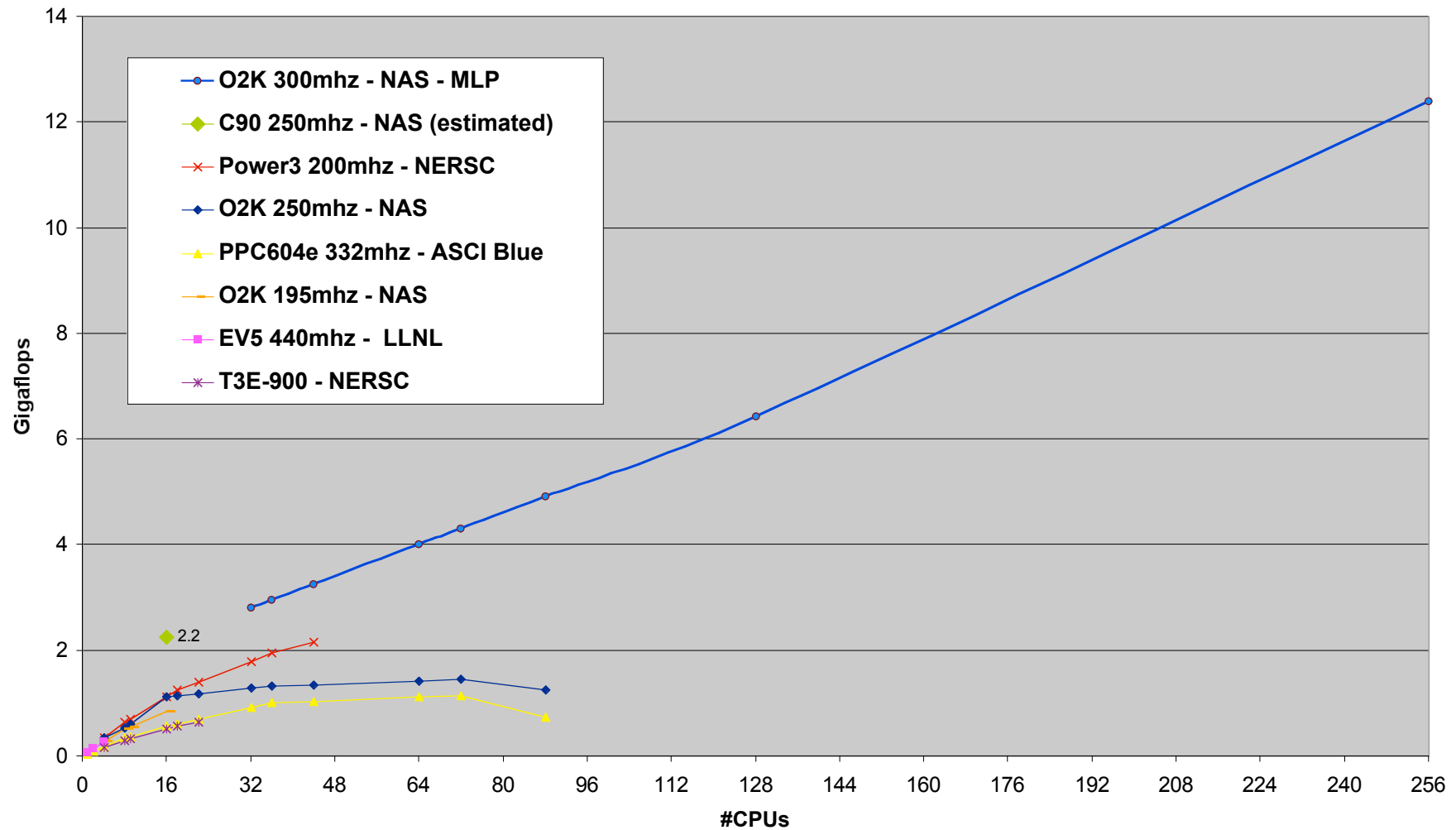




# Earth Systems Modeling



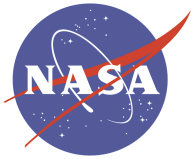
FVCORE 2x2.5@55 Levels (B55)





# Virtual Space Station





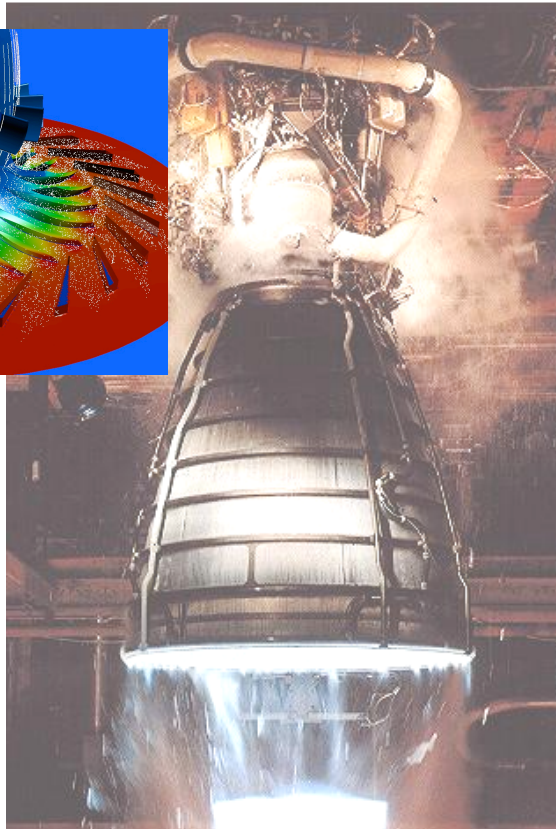
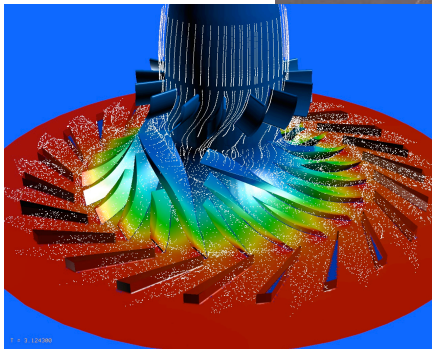
# Space Flight Simulations



## LIQUID SUB-SYSTEMS ANALYSIS

### Power Head

- Feed line, Turbo-pump
- Preheating/Nozzle cooling
- Weight and life cycle



## HIGH-FIDELITY ASCENT SIMULATION

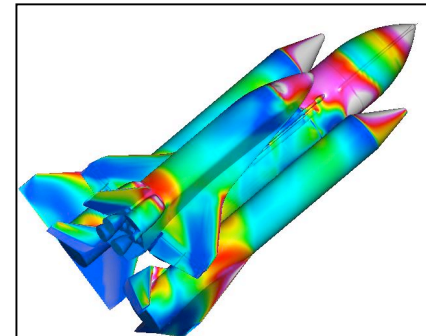
### Launch Process

- Start up
- Plume/base heating
- Launch pad



### Mission Abort

- conceptual designs
- probabilistic failure prediction
- trajectory optimization
- flight performance



### Stage Separation

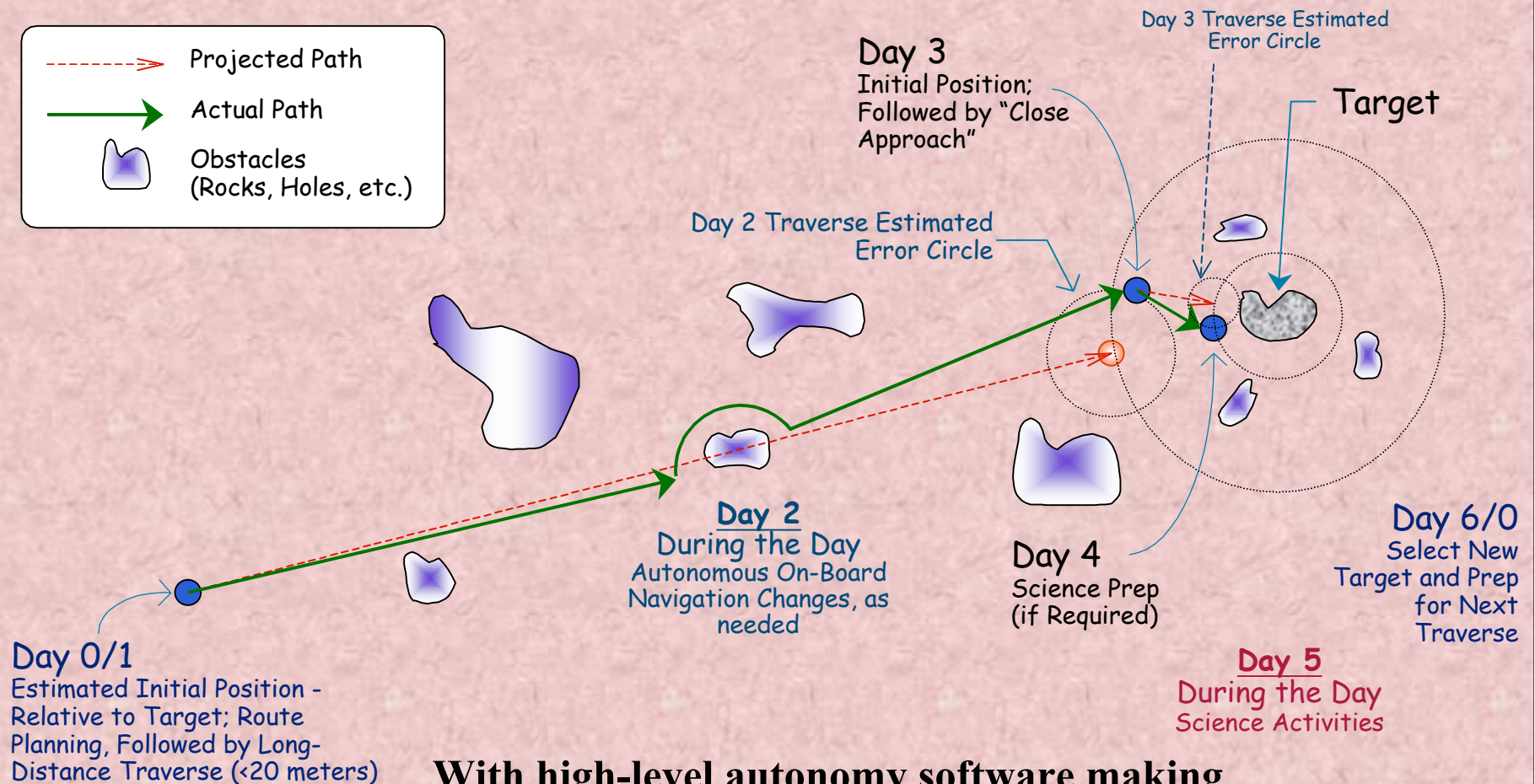
- Multiple body
- Liquid glide-back booster





# Need for Autonomy

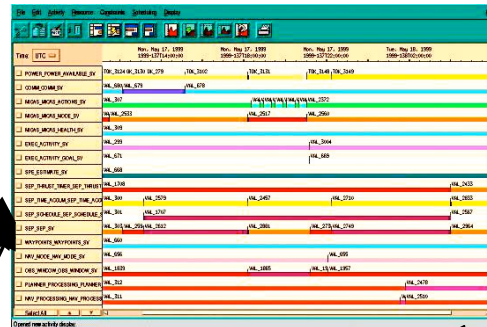
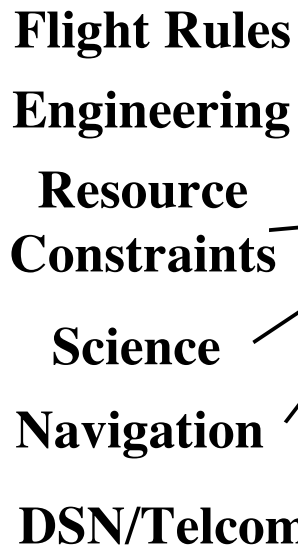
## Example: Exploration Surface Operations



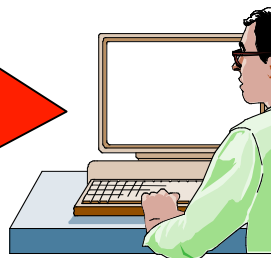
**With high-level autonomy software making local decisions without intervention from Earth, this 6-day sequence can be reduced to 15 minutes**



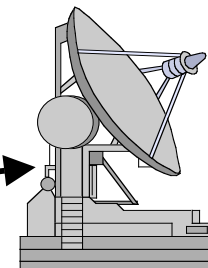
# Remote Agent Automated Planning System

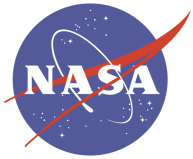


## Verification

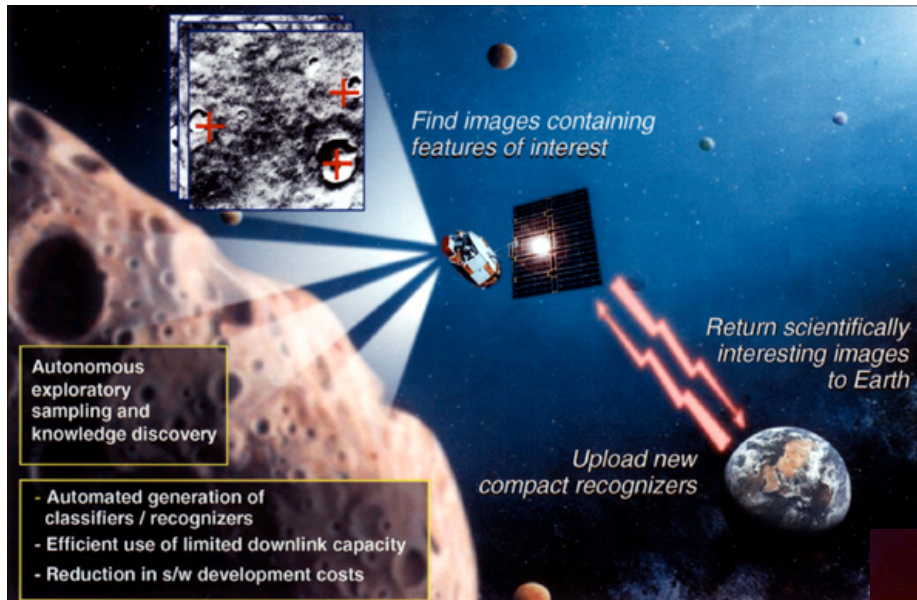


## Science Team





# Intelligent Sensing and Reflexive Behavior



Detect science opportunity...

- Solar flare
- Volcanic eruption
- Interesting Mars rock
- Geologic process

... and react

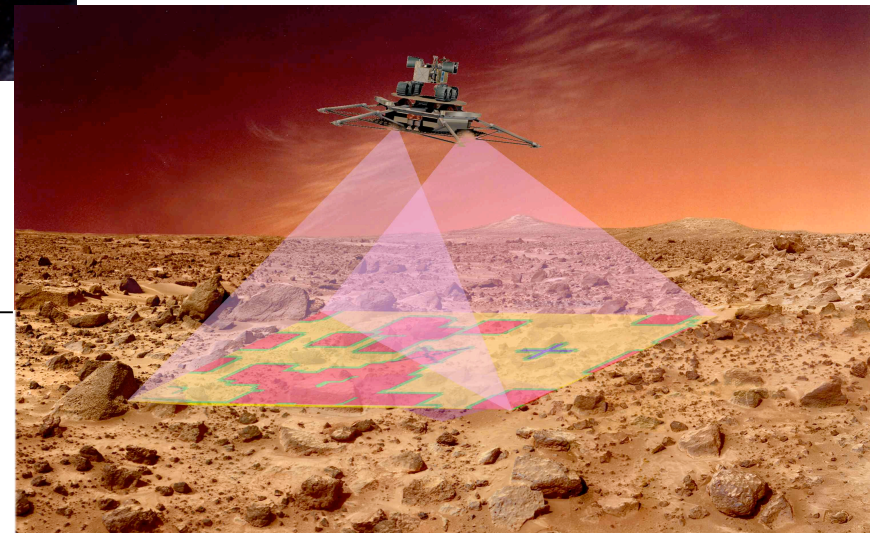
- Generate new plan to observe event
- Downlink “interesting” events

Assess environment ...

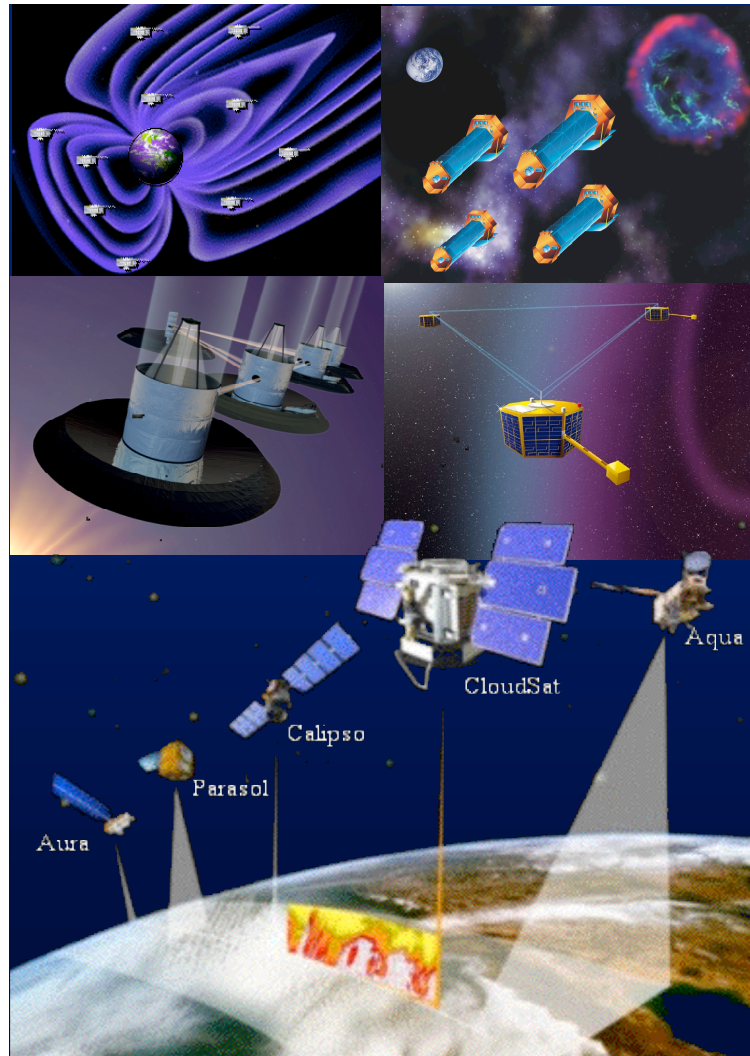
- Estimate position & pose
- Find safe landing sites
- Find scientifically interesting sites

... and react

- Navigate to site & land safely

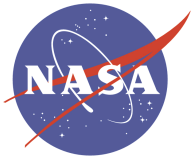






- Low-cost, scalable ground operations for multiple-asset missions.
- Collective planning and scheduling to enable coordinated operations
- Low-bandwidth approaches to onboard coordination.
- Ad hoc networking of existing satellites
- Collective fault detection, isolation and recovery.



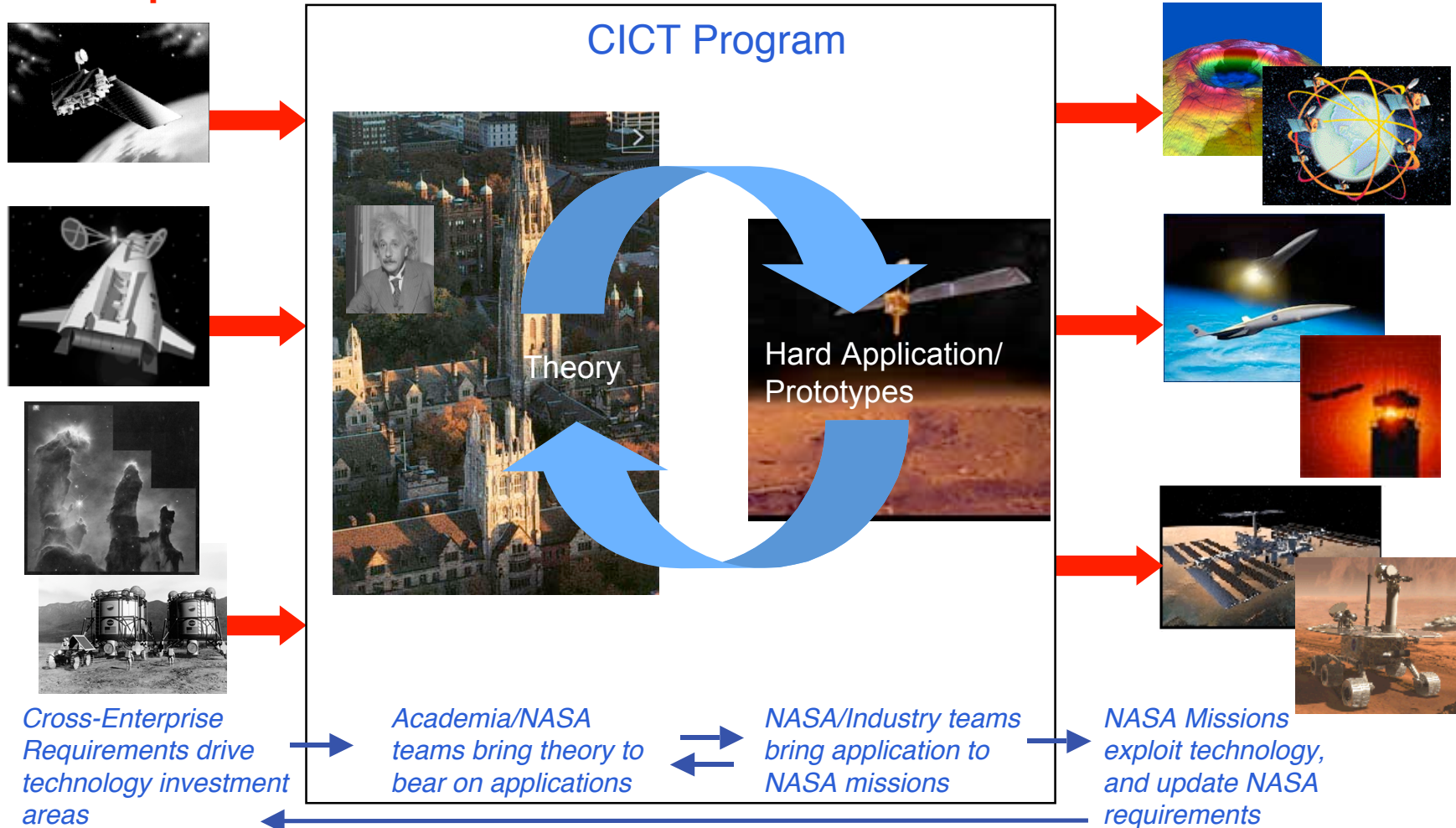


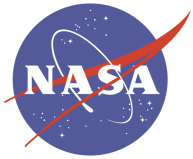
# CICT Technology Development & Application



## NASA Cross-Enterprise CIC Requirements

## NASA Mission Programs





# CICT Role In NASA Technology Flow

